Staged endovascular stent grafts for concurrent mobile/ulcerated thrombi of thoracic and abdominal aorta causing recurrent spontaneous distal embolization

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Mobile thrombus of the thoracic aorta is an uncommon pathology with potentially catastrophic complications. Recurrent spontaneous distal embolization may also occur from an ulcerated thrombus of the abdominal aorta. The simultaneous presence of a mobile thrombus in the thoracic aorta and ulcerated thrombus of the abdominal aorta is extremely rare and poses a significant treatment dilemma. Although various approaches have been reported, there is no standard treatment. Direct replacement of the thoracoabdominal aorta is extremely morbid, while continued embolization despite anticoagulation mandate intervention. We herein present the first case report of successful treatment of symptomatic mobile/ulcerated thrombi of the thoracic and abdominal aorta using staged endovascular stent graft repair. Successful treatment of the thoracic component with a thoracic aortic graft (TAG, Gore-Tex, W. L. Gore & Assoc., Flagstaff, Ariz.) was followed one week later by exclusion of the infrarenal aortic lesion with a bifurcated stent graft. Endovascular stent graft exclusion of mobile/ulcerated thoracic and abdominal aortic thrombi is a minimal invasive operation. It can be employed as an alternative procedure in treatment of aortic thrombus with embolization in high risk patients. Long-term follow-up will be necessary to assess the durability of this technique. (J Vasc Surg 2008;47:193-6.)

Mobile thrombus of the aorta is an uncommon pathology with potentially catastrophic embolic complications. Recurrent spontaneous distal embolization may also occur from an ulcerated thrombus of the abdominal aorta. Various treatment options have been documented, including anticoagulation alone, thrombolysis, thromboaspiration, balloon-catheter thrombectomy, open thrombectomy, thromboendarterectomy, aortic replacement, and endovascular exclusion.[1-5] However, standard management of mobile/ulcerated thrombi has not been well established. Open surgery of the thoracoabdominal aorta is associated with high morbidity and mortality, while recurrent embolization despite anticoagulation mandates intervention.

The simultaneous presence of a mobile thrombus in the thoracic aorta and ulcerated thrombus of the abdominal aorta is extremely rare. We herein present the first case report of successful treatment of symptomatic mobile/ulcerated thrombi of the thoracic and abdominal aorta using staged endovascular stent grafts.

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Competition of interest: None.

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0741-5214/$34.00

doi:10.1016/j.jvs.2007.07.050

CASE REPORT

A 70-year-old male presented to the emergency department at a community hospital with the sudden onset of left buttock and lower extremity pain with blue toes. Angiography demonstrated bilateral iliac stenosis with distal embolization in the left foot reportedly. Bilateral iliac artery stenting was performed. The patient was treated with intravenous heparin initially and discharged home with warfarin and aspirin.

Two weeks later, the patient came to our university medical center with left foot wet gangrene. Guillotine amputation was performed emergently and followed by revision and closure of the below knee amputation. To evaluate for a possible embolic source, transesophageal echography (TEE) revealed a 1 × 3 cm floating thrombus in the descending thoracic aorta. Computed tomography (CT) scan with intravenous contrast showed a mobile thoracic thrombus (Fig 1), which is consistent with the TEE findings and ulcerated thrombus in the infrarenal abdominal aorta (Fig 2). The patient was heparinized initially and was discharged home with warfarin and aspirin.

One week later, the patient presented to our clinic with acute pain and bluish discoloration in the right first and third toes. The laboratory study showed eosinophylia with eosinophil 7.5% (normal <6.5%). We decided to perform endovascular exclusion of the thoracic and abdominal thrombi for recurrent embolization. To

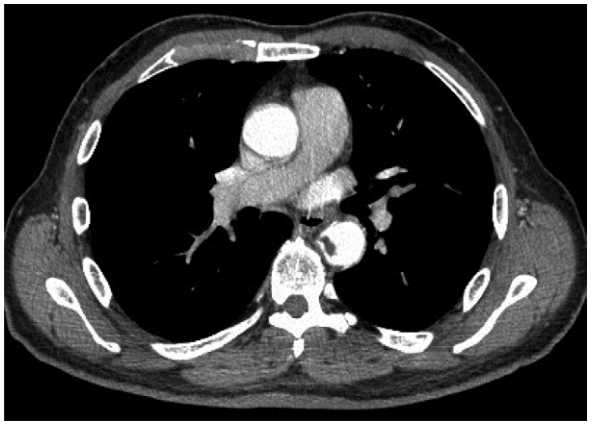

Fig 1. Computed tomography (CT) scan with intravenous contrast showed a mobile thrombus attached to the medial wall of the descending thoracic aorta.

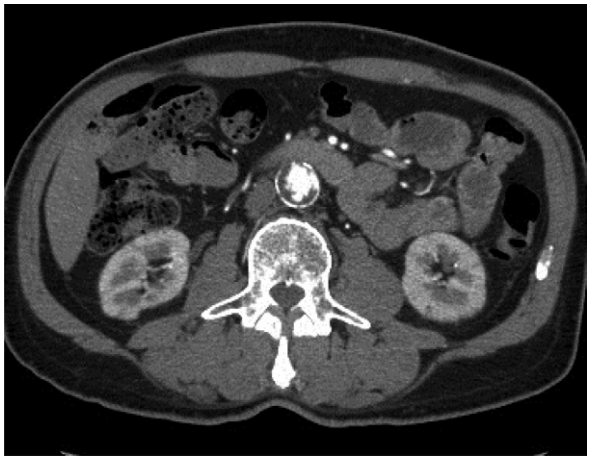

Fig 2. CT scan revealed ulcerated thrombus in the infrarenal abdominal aorta.

avoid spinal ischemia, we planned to have the operation staged. Since the mobile thoracic thrombus could not be excluded as the source of embolization and had a possibly higher risk of causing visceral ischemia, exclusion of the thoracic component was performed first.

Bilateral common femoral arteries were exposed. An angled catheter was used to direct the wire away from the mobile thrombus while advancing it into the proximal thoracic aorta. A 22F introducer sheath was inserted through the right femoral artery and positioned into the abdominal aorta above the renal artery. An 18F introducer sheath was placed through the left femoral artery and advanced into the distal aorta immediately above the bifurcation. The bilateral common iliac arteries were temporarily sealed by the sheaths. This was confirmed by intraoperative angiogram, which showed no blood flow around the sheaths in both common iliac arteries. The potential of pelvic and lower extremity embolization was thus prevented during the procedure. The total iliac occlusion time was 30 minutes. The mobile thrombus could not be

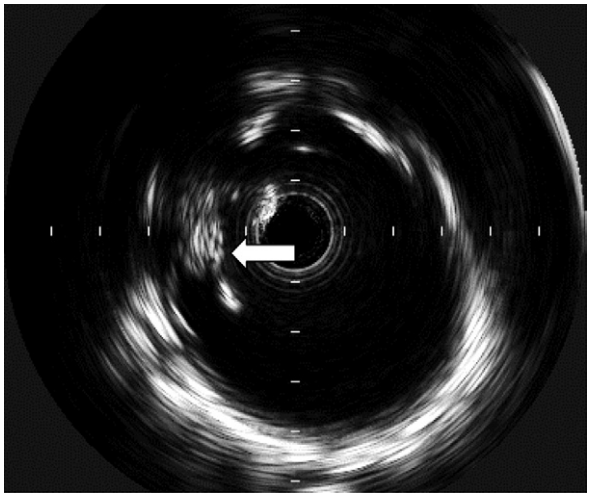

Fig 3. Intravascular ultrasound (IVUS) located the mobile thrombus attached to the medial wall of the descending thoracic aorta (arrow), which was consistent with the CT findings.

visualized by intraoperative aortography with anterior-posterior, lateral, 30 degree and 50 degree views. Intravascular ultrasound (IVUS) was performed, and the thrombus was clearly located (Fig 3). A 34 mm × 10 cm thoracic aortic stent graft (TAG, Gore-Tex, W. L. Gore & Assoc, Flagstaff, Ariz) was then inserted and deployed under the guidance of IVUS and fluoroscopy. Excellent positioning of the TAG stent graft was confirmed by IVUS and fluoroscopy. The introducers, before being removed, were withdrawn into the proximal common iliac arteries. Forward bleeding was allowed through the side ports of the introducer sheathes to flush out the possible debris. There was no any evidence of visceral, spinal cord, or limb ischemia postoperatively. The patient was returned to the operating room 1 week later. Bilateral femoral artery exposure was again done through the previous incisions. A bifurcated Gore Excluder abdominal aortic stent graft (Gore-Tex, W. L. Gore & Assoc., Flagstaff, Ariz.) was introduced using the same technique as for endovascular abdominal aortic aneurysm repair. A 26 × 12 × 14 trunk-ipsilateral stent graft was deployed through the left femoral artery and a 12 × 10 contralateral leg component through the right femoral artery under fluoroscopic guidance. No complication developed.

A follow-up CT scan demonstrated well-positioned stent grafts in the thoracic and abdominal aorta (Fig 4, *A*). The mobile thoracic thrombus and ulcerated abdominal aortic thrombi were completely excluded (Fig 4, *B*). The patient was discharged home with oral anticoagulant and aspirin. The dry gangrene of his right first and third toe healed spontaneously. The patient has been symptom-free for 9 months.

DISCUSSION

More than 80% of arterial emboli originate in the heart.[6] Five to ten percent of patients have emboli from aneurysms of the aortoiliac, femoral, popliteal, or subclavian arteries.[7] Distal arterial embolization from mobile thoracic aortic thrombi is rare. Fewer than 130 cases have been reported.[1] Although more mobile thoracic aortic

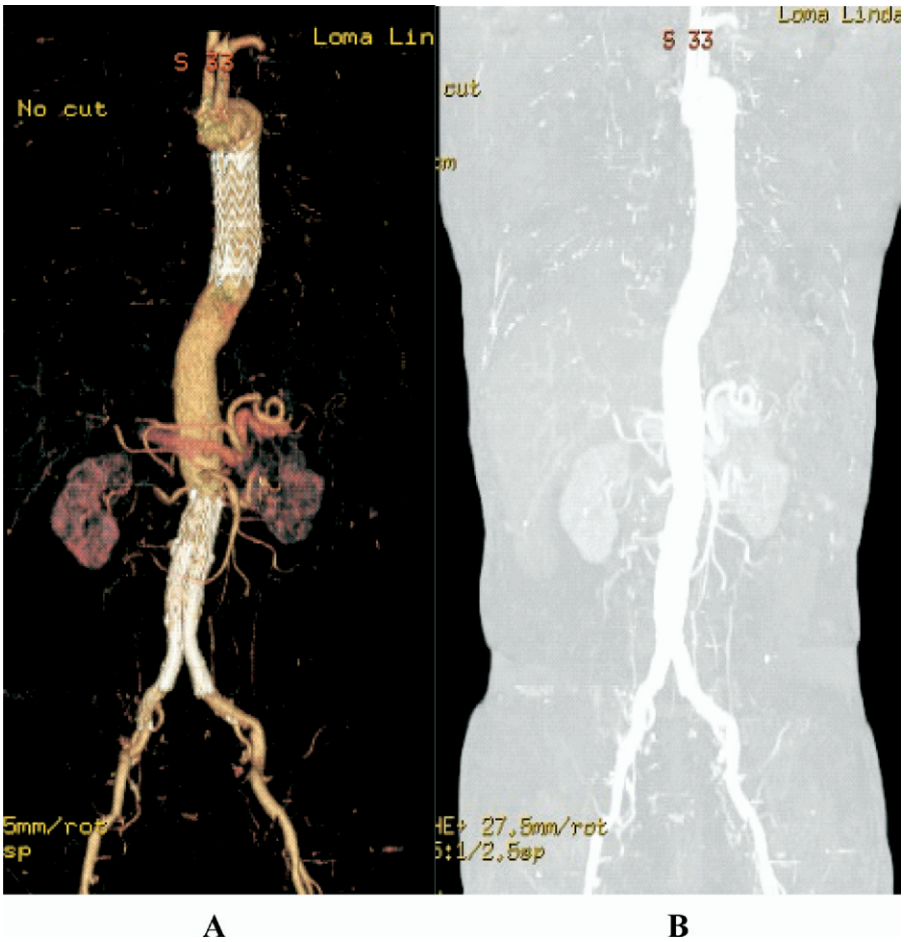

Fig 4. Follow-up CT scan with reconstruction demonstrated that the stent grafts were in good position (**A**); and thoracic and abdominal thrombi were completely excluded (**B**).

thrombi have been seen because of the wide use of echocardiography, spontaneous embolization secondary to the simultaneous presence of a mobile thrombus of the thoracic aorta and ulcerated thrombus of the abdominal aorta remains relatively uncommon.

The optimal treatment of mobile/ulcerated aortic thrombus remains undefined. Anticoagulation alone can not effectively prevent recurrent embolization.[8] Open surgical approaches have a perioperative morbidity of 29% and mortality of 2.6% to 20%.[9,10] Choukroun and coworkers reported that the recurrence rate of distal embolization was 25% following open thrombectomy for descending thoracic aortic thrombus.[1] The residual atherosclerotic lesion in the aortic wall may promote the development of recurrent thrombus after thrombectomy alone. Treatment with endovascular stent grafts not only excludes the thrombus but also covers the underlying atherosclerotic aortic wall. A few cases have reported the treatment of mobile/ulcerated aortic thrombus by deploying stent grafts into thoracic or abdominal aorta.[3-5] To our knowledge, endovascular exclusion of concurrent thoracic and abdominal aortic mobile/ulcerated thrombi using stent grafts has not been described in the English literature.

Endovascular exclusion of simultaneous thoracic and abdominal aortic thrombi is not a simple combination of deploying stent grafts into the thoracic and abdominal aorta. The following questions should be answered before surgery: (1) Can the thoracic and abdominal aorta be covered with stent grafts at the same time, or should the grafts be placed in staged fashion? (2) If staged surgery is planned, which component should be performed first? (3) How can perioperative spinal cord ischemia be prevented? (4) How can the thrombus be located during surgery? (5) How can visceral, pelvic and lower extremity embolization be prevented?

Endovascular stent graft repair of the thoracic or thoracoabdominal aorta is associated with a risk of perioperative spinal cord ischemia occurring in 3% to 12% of patients.[10] Simultaneous coverage of thoracic and abdominal aorta should be avoided if it is not absolutely necessary. Because the mobile thoracic thrombus could not be excluded as the source of embolization and it has a possibly

higher risk of causing visceral ischemia, we decided to treat the thoracic thrombus first, and to perform the abdominal aortic stent graft one week later. Using this approach, no neurologic complication developed. One stage covering of thoracic and infrarenal abdominal aorta could be an alternative strategy. However, unlike endovascular repair of thoracoabdominal aneurysm, simultaneous covering of thoracic and abdominal aorta is not absolutely necessary for excluding aortic thrombi. We successfully performed this case in staged fashion without spinal drainage, but we would like to emphasize that the drain should be placed immediately if any sign of neurologic deficit develops postoperatively. Intra- and postoperative hypotension should also be prevented and corrected aggressively.

Intraoperative localization of the mobile thrombus can be problematic. Angiography may frequently miss aortic thrombus.[1,3] Criado and colleagues described a case using TEE to guide thoracic stent graft placement for thrombus exclusion when angiography could not demonstrate the lesion. In our patient, intraoperative angiography with multiple angulations was unable to visualize the mobile thrombus. IVUS was performed and the thrombus was accurately located (Fig 3). Although IVUS may increase the risk of distal embolization compared with TEE, it can be a valuable alternative modality if the surgeon has adequate experience. Minimal manipulation of the IVUS catheter is crucial.

Mobile thrombus is usually eccentric with a pedunculated attachment to the aortic wall.[1] To minimize the possible dislodgment of the thrombus, we used an angled catheter to direct the guide wire away from the thrombus while advancing it into the proximal aorta. The ipsilateral introducer sheath should be inserted and positioned above the renal arteries if the patient has infrarenal aortic thrombus as well. The disturbance of the abdominal aortic thrombus from the manipulation of wires and catheters is thereby minimized. Large introducer sheaths may also be able to seal the iliac arteries and in this patient, intraoperative angiography demonstrated no blood flow around the sheaths. The distal flow is also temporarily occluded. At the end of surgery, the proximal ends of the introducer sheaths can be withdrawn into the common iliac arteries and forward flushing of debris allowed by opening the side ports of the sheaths to limit embolization of internal iliac and lower extremity arteries. However, this technique is not effective in the patients with large iliac arteries or when angiography shows blood flow around thesheaths. It also does not provide protection against postintervention embolization.

There is no effective protection for visceral embolization during this type of procedure. Manipulation of the wires and catheters should be minimized. We agree to Fueglistaler's recommendation that visceral angiography should be routinely employed to detect potential embolic events at the end of surgery and treat them simultaneously.[9] Furthermore, anticoagulation and antiplatelet agents are recommended to prevent recurrent embolization postoperatively[1,5]

In conclusion, endovascular stent graft exclusion of mobile/ulcerated thoracic and abdominal aortic thrombi is a minimal invasive operation. It can be employed as an alternative procedure in the treatment of aortic thrombus with embolization in high risk patients. Long-term follow-up will be necessary to assess the durability of this technique.

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Submitted Apr 12, 2007; accepted Jul 26, 2007.